

WHAT IS CLAIMED IS:

1. A method for reducing a mixture of a plurality of malto-oligosaccharide species to a DE of essentially zero, said plurality of malto-oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture, the method comprising the steps of:

providing said malto-oligosaccharide mixture, and
catalytically hydrogenating said mixture of malto-
oligosaccharide species under hydrogenation conditions
suitable to substantially preserve the DP profile of said
mixture.

2. Method according to claim 1, said method including a step of hydrogenating said mixture in the presence of a metal hydrogenation catalyst.

3. Method according to claim 2, said catalyst being a metal catalyst selected from the group consisting of platinum, palladium, ruthenium, rhodium, and activated nickel.

4. Method according to claim 3, said catalyst being activated nickel.

5. Method according to claim 4, said catalytic hydrogenation being performed at a temperature ranging from about 50° C to about 150° C and a pressure ranging up to about 1500 psi.

6. Method according to claim 5, said catalytic hydrogenation being performed at a temperature ranging from about 100° C to about 130° C and a pressure ranging up to about 1500 psi.

7. Method according to claim 6, said pressure ranging from about 200 psi to about 1500 psi.

8. Method according to claim 6, said temperature ranging from about 110° C to about 120° C and said pressure ranging from about 400 psi to about 700 psi.

9. Method according to claim 1, at least one of said plurality of species having a DP greater than 5.

10. Method according to claim 1, at least one of said species having a DP greater than about 8.

11. Method according to claim 1, at least one of said species having a DP greater than about 10.

12. Method according to claim 1, at least about 80% of said species having a DP greater than 5.

13. Method according to claim 12, at least about 60% of said species having a DP greater than 8.

14. Method according to claim 13, at least about 60% of said species having a DP greater than 10.

15. Method according to claim 14, at least about 80% of said species having a DP greater than 10.

16. Method according to claim 1, at least about 75% of said species having a DP greater than 5 and at least about 40% of said species having a DP greater than 10.

17. Method according to claim 1, wherein said malto-oligosaccharide mixture has a DE of 19 or less prior to hydrogenation.

18. Method according to claim 1, wherein the mixture of malto-oligosaccharides is catalytically hydrogenated at a pH ranging from about 3.5 to about 8.5

19. Method according to claim 18, wherein said pH ranges from about 4.5 to about 8.5.

20. Method according to claim 19, wherein said pH ranges from about 5.0 to about 6.0

21. Process for the reduction of a malto-oligosaccharide mixture, the process comprising the steps of:

providing a catalytic bed including a hydrogenation catalyst;

providing a malto-oligosaccharide mixture including a plurality of malto-oligosaccharide species, said plurality of malto-oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture,

continuously introducing a malto-oligosaccharide mixture and hydrogen to said catalytic bed under hydrogenation conditions sufficient to catalytically hydrogenate said mixture to substantially reduce the DE thereof, said conditions being suitable to substantially preserve the DP profile of said mixture.

22. Process according to claim 21, said catalyst being a metal catalyst selected from the group consisting of platinum, palladium, ruthenium, rhodium, and activated nickel.

23. Process according to claim 22, said metal catalyst being activated nickel.

24. Process according to claim 23, said catalytic hydrogenation being performed at a temperature ranging from about 100° C to about 130° C and a pressure ranging up to about 1500 psi.

25. Process according to claim 24, said pressure ranging from about 200 psi to about 1500 psi.

26. Process according to claim 24, said pressure ranging from about 400 psi to about 700 psi and said temperature ranging from about 110° C to about 120° C.

27. Process according to claim 21, at least one of said species having a DP greater than about 5.

28. Process according to claim 21, at least one of said species having a DP greater than about 8.

29. Process according to claim 21, at least about 80% of said species having a DP greater than 5.

30. Process according to claim 29, at least about 60% of said species having a DP greater than 8.

31. Process according to claim 30, at least about 60% of said species having a DP greater than 10.

32. Process according to claim 21, at least about 80% of said species having a DP greater than 10.

33. Process according to claim 21, at least 75% of said species having a DP greater than 5 and at least about 40% of said species having a DP greater than 10.

34. Process according to claim 21, wherein said malto-oligosaccharide mixture is reduced in said catalytic bed at a pH ranging from 3.5 to about 8.5

35. Process according to claim 34, wherein said pH ranges from about 4.5 to about 5.5.

36. Process according to claim 35, wherein said pH ranges from about 5.0 to about 6.0.

37. Product prepared by a process comprising the steps of:

providing a mixture of a plurality of malto-oligosaccharide species, said plurality of malto-oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture; and

catalytically hydrogenating said mixture of malto-oligosaccharide species under hydrogenation conditions sufficient to substantially preserve the DP profile of said mixture and to substantially reduce the DE of said species.

38. Product according to claim 37, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

39. Product according to claim 37, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

40. Product according to claim 39, at least one of said plurality of species having a DP greater than 5.

41. Product according to claim 39, at least one of said species having a DP greater than about 8.

42. Product according to claim 39, at least one of said species having a DP greater than about 10.

43. Product according to claim 39, at least about 80% of said species having a DP greater than 5.

44. Product according to claim 43, at least about 60% of said species having a DP greater than 8.

45. Product according to claim 44, at least about 60% of said species having a DP greater than 10.

46. Product according to claim 45, at least about 80% of said species having a DP greater than 10.

47. Product according to claim 31, at least about 75% of said species having a DP greater than 5 and at least about 40% of said species having a DP greater than 10.

48. Method for preparing a reduced malto-oligosaccharide comprising the steps of:

providing a starch;

hydrolyzing said starch to provide a mixture of malto-oligosaccharide species, said plurality of malto-oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture; and

catalytically hydrogenating said malto-oligosaccharide species under hydrogenation conditions suitable to substantially preserve the DP profile of said mixture and to substantially reduce the DE of said mixture.

49. Method according to claim 48, at least about 80% of said species having a DP greater than 5.

50. Method according to claim 49, at least about 60% of said species having a DP greater than 8.

51. Method according to claim 50, at least about 60% of said species having a DP greater than 10.

52. Method according to claim 51, at least about 80% of said species having a DP greater than 10.

53. Method according to claim 48, at least about 75% of said species having a DP greater than 5 and at least about 40% of said species having a DP greater than 10.

54. Method according to claim 48, wherein said malto-oligosaccharide mixture is catalytically hydrogenated at a pH ranging from about 3.5 to about 8.5.

55. Method according to claim 54, wherein said pH ranges from about 4.5 to about 6.5.

56. Method according to claim 55, wherein said pH ranges from about 5.0 to about 6.0

57. Method for reducing a mixture of a plurality of oligosaccharide species to a DE of essentially zero, said plurality of oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture, the method comprising the steps of:

providing said oligosaccharide mixture; and

catalytically hydrogenating said mixture of oligosaccharide species under hydrogenation conditions suitable to substantially preserve the DP profile of said mixture.

58. Method according to claim 57, at least about 80% of said species having a DP greater than 5.

59. Method according to claim 58, at least about 60% of said species having a DP greater than 8.

60. Method according to claim 59, at least about 60% of said species having a DP greater than 10.

61. Method according to claim 60, at least about 80% of said species having a DP greater than 10.

62. Method according to claim 57, at least about 75% of said species having a DP greater than 5 and at least about 40% of said species having a DP greater than 10.

63. Mixture of plurality of reduced malto-oligosaccharide species, each of said species comprising a plurality of 1,4-linked glucose residues, said mixture having a DE of essentially zero, at least about 80% of said species having a DP greater than 5.

64. Mixture according to claim 63, at least about 60% of said species having a DP greater than 10.

65. Mixture according to claim 64, at least about 80% of said species having a DP greater than 10.

66. Mixture of plurality of reduced malto-oligosaccharide species, each of said species comprising a plurality of 1,4-linked glucose residues, said mixture having a DE of essentially zero, at least about 75% of said species having a DP greater than 5 and at least 40% of said species having a DP greater than 10.

() 67. Mixture according to claim 66, said mixture having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

() 68. Mixture according to claim 67, said mixture having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

69. Mixture according to claim 66, at least about 80% of said species having a DP greater than 10.

70. Method for substantially reducing the DE of a malto-oligosaccharide mixture, the method comprising the steps of:
providing a malto-oligosaccharide mixture,
said mixture having a DE greater than 2 and having the following approximate profile:

DP	DP profile (% dry solids basis)
DP>8	46.6
DP 8	3.9
DP 7	9.5
DP 6	11.4
DP 5	5.9
DP 4	6.4
DP 3	8.3
DP 2	6.2
DP 1	1.8

catalytically hydrogenating said malto-oligosaccharide mixture in a reaction mixture under the following reaction conditions:

Pressure 400 psi - 700 psi

Temperature 100° C to 130° C

and recovering a reduced malto-oligosaccharide mixture from said reaction mixture, the DE of said reduced malto-oligosaccharide mixture being substantially reduced and the DP profile of said malto-oligosaccharide mixture being substantially preserved.

71. Reduced malto-oligosaccharide product prepared in accordance with the method of claim 70.

72. Product according to claim 71, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

73. Product according to claim 72, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

74. Method for substantially reducing the dextrose equivalent value of a malto-oligosaccharide mixture, the method comprising the steps of:

providing a malto-oligosaccharide mixture,
 () said mixture having a DE value greater than 2 and having
 the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	54.7
DP 8	4.8
DP 7	9.1
DP 6	8.4
DP 5	4.7
DP 4	5.5
DP 3	6.7
DP 2	4.8
DP 1	1.3

catalytically hydrogenating said malto-oligosaccharide mixture in a reaction mixture under the following reaction conditions:

Pressure 400 psi - 700 psi

Temperature 100° C to 130° C

and recovering a reduced malto-oligosaccharide mixture from said reaction mixture, the DE of said reduced malto-oligosaccharide mixture being substantially reduced and the DP profile of said malto-oligosaccharide mixture being substantially preserved.

75. Reduced malto-oligosaccharide product prepared in accordance with the method of claim 74.

76. Product according to claim 75, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

77. Product according to claim 75, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

78. Method for substantially reducing the dextrose equivalent value of a malto-oligosaccharide mixture, the method comprising the steps of:

providing a malto-oligosaccharide mixture,
said mixture having a DE value greater than 2 and having
the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	67.8

DP	DP profile (% dry solids basis)
DP 8	4.5
DP 7	7.0
DP 6	6.1
DP 5	3.3
DP 4	3.7
DP 3	4.2
DP 2	2.5
DP 1	0.7

catalytically hydrogenating said malto-oligosaccharide mixture in a reaction mixture under the following reaction conditions:

Pressure 400 psi - 700 psi

Temperature 100° C to 130° C

and recovering a reduced malto-oligosaccharide mixture from said reaction mixture, the DE of said reduced malto-oligosaccharide mixture being substantially reduced and the DP profile of said malto-oligosaccharide mixture being substantially preserved.

79. Reduced malto-oligosaccharide product prepared in accordance with the method of claim 78.

80. Product according to claim 79, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

81. Product according to claim 79, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

82. Method for substantially reducing the dextrose equivalent value of a malto-oligosaccharide mixture, the method comprising the steps of:

providing a malto-oligosaccharide mixture,
 said mixture having a DE value greater than 2 and having
 the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	90.6
DP 8	1.5
DP 7	1.5
DP 6	1.4
DP 5	1.3
DP 4	1.1
DP 3	1.0
DP 2	0.8
DP 1	0.8

catalytically hydrogenating said malto-oligosaccharide mixture in a reaction mixture under the following reaction conditions:

Pressure 400 psi - 700 psi

Temperature 100° C to 130° C
 and recovering a reduced malto-oligosaccharide mixture from said reaction mixture, the DE of said reduced malto-oligosaccharide mixture being substantially reduced and the DP profile of said malto-oligosaccharide mixture being substantially preserved.

83. Reduced malto-oligosaccharide product prepared in accordance with the method of claim 82.

84. Product according to claim 82, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

85. Product according to claim 82, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

86. Method for substantially reducing the dextrose equivalent value of a malto-oligosaccharide mixture, the method comprising the steps of:

providing a malto-oligosaccharide mixture,
 said mixture having a DE value greater than 2 and having
 the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	88.5

DP	DP profile (% dry solids basis)
DP 8	2.0
DP 7	2.4
DP 6	1.8
DP 5	1.3
DP 4	1.4
DP 3	1.4
DP 2	0.9
DP 1	0.3

catalytically hydrogenating said malto-oligosaccharide mixture in a reaction mixture under the following reaction conditions:

Pressure 400 psi - 700 psi

Temperature 100° C to 130° C

and recovering a reduced malto-oligosaccharide mixture from said reaction mixture, the DE of said reduced malto-oligosaccharide mixture being substantially reduced and the DP profile of said malto-oligosaccharide mixture being substantially preserved.

87. Reduced malto-oligosaccharide product prepared in accordance with the method of claim 86.

88. Product according to claim 87, said product having an absorbance of less than about 0.25 after a 10% aqueous

solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

89. Product according to claim 87, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

90. A reduced maltodextrin having a DE of substantially zero and the following approximate DP profile:

()

DP	DP profile (% dry solids basis)
DP>8	46.6
DP 8	3.9
DP 7	9.5
DP 6	11.4
DP 5	5.9
DP 4	6.4
DP 3	8.3
DP 2	6.2
DP 1	1.8

91. Product according to claim 90, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10

92. Product according to claim 90, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

93. A reduced maltodextrin having a DE of substantially zero and the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	54.7
DP 8	4.8
DP 7	9.1

DP 6	8.4
DP 5	4.7
DP 4	5.5
DP 3	6.7
DP 2	4.8
DP 1	1.3

94. Product according to claim 93, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

95. Product according to claim 93, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

96. A reduced maltodextrin having a DE of substantially zero and the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	67.8
DP 8	4.5
DP 7	7.0
DP 6	6.1
DP 5	3.3

DP 4	3.7
DP 3	4.2
DP 2	2.5
DP 1	0.7

97. Product according to claim 96, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

98. Product according to claim 96, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

99. A reduced maltodextrin having a DE of substantially zero and the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	90.6
DP 8	1.5
DP 7	1.5
DP 6	1.4
DP 5	1.3
DP 4	1.1
DP 3	1.0
DP 2	0.8

DP	DP profile (% dry solids basis)
DP 1	0.8

100. Product according to claim 99, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

101. Product according to claim 99, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

102. A reduced maltodextrin having a DE of substantially zero and the following approximate DP profile:

DP	DP profile (% dry solids basis)
DP>8	88.5
DP 8	2.0
DP 7	2.4
DP 6	1.8
DP 5	1.3
DP 4	1.4
DP 3	1.4
DP 2	0.9

DP 1	0.3
------	-----

103. Product according to claim 102, said product having an absorbance of less than about 0.25 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

104. Product according to claim 102, said product having an absorbance of less than about 0.15 after a 10% aqueous solution of said product has been held for two hours at about 75° C at a pH ranging from about pH 9 to pH 10.

105. A method for reducing a mixture of a plurality of malto-oligosaccharide species to a DE of essentially zero, said plurality of malto-oligosaccharide species differing at least in DP value thus defining a DP profile for said mixture, the method comprising the steps of:

providing said malto-oligosaccharide mixture; and catalytically hydrogenating said malto-oligosaccharide mixture in an aqueous solution at a pH ranging from about 3.5 to about 8.5.

106. A method according to claim 105, wherein said pH ranges from about 4.5 to about 6.5.

107. A method according to claim 106, wherein said pH ranges from about 5.0 to about 6.0.

108. A lyophilization method comprising the steps of:
providing a biological sample in an aqueous
solution;
adding to said sample a reduced malto-
oligosaccharide to thereby form a combination; and
lyophilizing said combination.